

National Park Service
Fire Island National Seashore
Invasive Species Inventory and Mapping Project

December 2002

By
Kathy L. Schwager

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INTRODUCTION

There has been growing concern about exotic species in the United States in recent years and the need to control them is now being recognized. Exotic species can alter or degrade wildlife habitat, displace many threatened and endangered species, reduce biodiversity by establishing weed monocultures, hybridize with native genotypes, transmit exotic diseases to native species, and they can cost millions of dollars to manage.

National Parks are home to a diverse array of native plant communities and exotic species are becoming an increasing threat to these resources. For these reasons, an invasive exotic plant inventory and mapping project was conducted by Fire Island National Seashore during the summer of 2002, as the first step in the development of an Integrated Pest Management (IPM) plan for the Park.

METHODS

Due to the large concentration of humans residing within park boundaries and the limited time and resources available for this project it was not feasible to conduct the inventory within the 17 communities found on the island. Therefore, this project was confined to NPS-owned lands, some of which consist of relatively small tracts of land (< 5 acres) found interspersed between the communities. The Sunken Forest/Sailors Haven tract and the Otis Pike Wilderness Area were among the larger tracts that were surveyed on Fire Island. Special attention was paid to areas where Park-owned lands border private, state-, and county-owned lands and to disturbed sites.

The methodology used to conduct the invasive species inventory and mapping project at FIIS is consistent with NPS procedures and is outlined in the publication *Guidelines for the Coordinated Management of Noxious Weeds: Development of Weed Management Areas* (McNeel et al. 1999), which was developed by the Bureau of Land Management, the National Park Service, and the United States Forest Service. A more detailed description can be found

in *Mapping Noxious Weeds in Montana* Extension Bulletin 148 (Cooksey and Sheley 1998) and the Montana Noxious Weed Survey and Mapping System *Weed Mapping Handbook* (Version 2.0) available from the Montana State University Cooperative Extension website (Roberts et. al. 1999).

GPS mapping was done using a Trimble GeoExplorer 3[®] GPS unit along with an external antenna. The GPS unit was set with the Universal Transverse Mercator (UTM) coordinate system, Zone 18 North, NAD 1983 datum and the altitude reference was set to mean sea level (MSL). All measurements were in meters.

A data dictionary containing the attribute information for all data was downloaded from the Montana State University Cooperative Extension website for use as a template. The weed species in this data dictionary were changed to reflect species that are of concern on Fire Island. By using the Data Dictionary Editor in Trimble's[®] Pathfinder Office 2.51 software, 6-letter NPS codes were used to represent each species identified in the field, generally the first 3 letters of the genus and the first 3 letters of the species name. Bamboo did not have a designated NPS code so a code was created using the same basic naming principles.

A complete list of inventoried species can be found in Table 1. The main species that were surveyed on Fire Island were autumn olive (*Eleagnus umbellata*), spotted knapweed (*Centaurea maculosa*), white poplar (*Populus alba*), Japanese honeysuckle (*Lonicera japonica*), bamboo spp. (*Phyllostachys* spp.), Japanese knotweed (*Polygonum cuspidatum*), multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), and Tree of Heaven (*Ailanthus altissima*).

Common reed (*Phragmites* spp.), Japanese black pine (*Pinus thunbergii*), and black locust (*Robinia pseudoacacia*), which are found on both Fire Island and the William Floyd Estate, were not included in this project for two reasons: these species are so abundant that to map all occurrences would have required more time and resources than were available, and because these species were already mapped (Klopfer et al. 2002). Areas dominated by

common reed or Japanese black pine were classified as the *Phragmites australis* tidal herbaceous alliance or the *Pinus thunbergii* forest alliance. Vegetation alliances are groups of physiognomically similar plant associations that have one or more dominant species in common (Mueller-Dombois and Ellenberg 1974). Black locust was not considered a dominant species and was therefore classified as a characteristic species of the *Quercus velutina* - *Quercus alba* – (*Quercus coccinea*) forest alliance (Klopfer et al. 2002).

The guidelines call for the mapping of survey areas in order to create an outline on a map of the entire area to be inventoried, however, it was not practical to map survey areas directly. Due to the high density of vegetation found on some sites, circumscribing the area on foot would have resulted in extensive damage to the native flora. In addition, since this inventory was limited to park lands it was determined that park boundaries would be sufficient to act as the survey area boundaries.

When a weed infestation was found, the first step in the mapping procedure was to determine what kind of file structure to create. A weed infestation can be designated as a weed point, weed line, or weed area. Weed areas, which represent areas greater than 5 acres, were not used because all infestations found covered less than 5 acres and, as mentioned previously, the dense vegetation often precluded delineating areas without causing excessive damage, therefore these infestations were designated as weed points. For maximum accuracy, at least 100 positions were taken for each weed point recorded (Roberts et. al. 1999).

In addition to entering the weed species into the data dictionary, the size of the infestation and the cover class must be entered. Infestation size was designated as 0.1 acre, 0.1-1.0 acre, or 1-5 acres for weed points. Cover class is an indication of the percentage of an area covered by a weed species and was categorized as trace (<1%), low (1-5%), moderate (5-25%), or high (25-100%).

Weed lines were used to designate infestations that follow a linear feature such as a road. There is no limit to the length of these features. The line is used as a reference to collect

direction from the line, i.e., left, right, or center depending on whether the infestation is located to the left or right, or is centered along the line that was walked; and "buffer width," which indicates the width of the infestation. The buffer width was measured in meters for this project.

Once an area was surveyed the data were transferred from the GPS datalogger to a desktop computer running Windows 98[®] and the Pathfinder Office[®] 2.51 software. The initial data had an accuracy of between 30 and 100 meters, but differential correction was performed to obtain data that was accurate to between <1 to 5 meters. Most differential correction was accomplished using base files from a base station located in Moriches, NY. The only exception was for those data collected on 22 July 2002 at Watch Hill. These data were corrected using base files from the base station at Sandy Hook, NJ. All base station files were downloaded directly from the National Geodetic Survey's (NGS) website for continuously operating reference stations (CORS) which can be found at <<http://www.ngs.noaa.gov/CORS/Data.html>>.

Metadata forms were adapted from the forms used by the Montana State University in its weed-mapping program (Appendix A). Each area surveyed has a corresponding metadata form that was completed after differential correction and lists the corresponding GPS file(s) for that area and the dates those data were collected. Metadata for the ArcView[®] shapefiles were also collected using the Metadata Collection Tool v2.0 extension for ArcView[®] (Appendix B).

Differentially corrected files were exported as sample ArcView shapefiles and the final maps were created in ArcView[®] 3.3. Shapefiles of Fire Island, the William Floyd Estate, the park boundary, the Long Island shoreline, and a shapefile depicting all public land were obtained from the park's GIS database and used as the base maps on which the invasive plant data were plotted. In order to best depict each survey site and the invasive species found there, it was determined that customizing the scale for each map would be more effective than using a uniform scale.

RESULTS AND DISCUSSION

A total of 13 areas were surveyed within the Park (Table 1). Two of those areas within the Otis Pike Wilderness Area include Bellport Beach and the eastern-most end of the Wilderness Area.

Lighthouse Tract

Autumn olive was the most prevalent weed species in the lighthouse tract (Figure 1). It appears to have originated from Robert Moses State Park where it was planted because it grows rapidly and provides cover for wildlife. Residents within the neighboring communities also plant autumn olive as an ornamental shrub. Oriental bittersweet was found in relatively dense patches along the driveway leading to the lighthouse.

Japanese honeysuckle, multiflora rose, common mullein, spotted knapweed, and nodding thistle (*Carduus nutans*) were also found in this area, especially along boardwalks leading to and from the lighthouse. Many of these species were found along the main road from Robert Moses State Park to the Ranger station. Vehicular as well as pedestrian and bicycle traffic are high in this area relative to other parts of the island and this provides a corridor for the spread of invasive species not only from the State Park, but also from Long Island.

Kismet/Seabay Beach Area

Along Burma Road both Oriental bittersweet and Japanese honeysuckle were found growing in relatively low densities (Figure 2). This is a high-traffic area with many pedestrians, bicycles, and vehicles traveling through this small tract of Park-owned land. Other species found were a few nodding thistle plants and a species of bamboo that had spilled over onto Park-owned lands from a resident's property.

Saltire Area

Nodding thistle was again found on this small tract of NPS land (Figure 3). There were a number of individual plants found here interspersed among native bayberry shrubs. Autumn olive and Japanese honeysuckle were also found growing along Burma Road which bisects this tract of land. Both of these species can be found growing as ornamentals in the neighboring

communities of Kismet and Saltaire. A single white poplar tree was also discovered here and appears to have originated from a tree growing on the property of a Saltaire resident.

Atlantique Area

This tract of land is somewhat larger than the 2 previously discussed areas. Only nodding thistle was found here and in small numbers covering areas of less than 1.0 acre (Figure 4).

Robbins Rest Area

This area is bordered on the west by the community of Robbins Rest and on the east by Corneille Estates. Burma Road goes through this tract and connects the 2 communities. Autumn olive was found along Burma Road and another road that enters from the beach and runs north until it meets Burma Road (Figure 5). An unidentified species of honeysuckle was also found along this road, choking a few bayberry shrubs. These were the only 2 species of invasive exotic plant found here.

Sunken Forest

A total of 6 weed species were found in the Sunken Forest area (Figure 6). The most prevalent was spotted knapweed that was found growing all along Burma Road. Driving on the beach in this area is prohibited so all vehicles must travel on Burma Road. The area along the road is extremely disturbed which may account for the abundance of spotted knapweed. This species was not found growing among native vegetation further away from the road.

Other species found here were autumn olive, Japanese honeysuckle, multiflora rose, nodding thistle, and Japanese knotweed. These species were found in very small, restricted areas. It is important to note Japanese knotweed is encroaching upon the Sunken Forest from the community of Cherry Grove where a significant infestation has been found.

Carrington Estate

Only one weed species, spotted knapweed, was found here and only in one small patch found around the house (Figure 7). The native vegetation is very dense throughout this area,

and although there is a network of trails found throughout this tract of NPS land, there is little more than pedestrian traffic going through here.

Talisman

As in the Sunken Forest, spotted knapweed was the most abundant species found here (Figure 8). Here again, it was found growing mostly in disturbed sites like along the road and boardwalk and around the bathhouse. Nodding thistle was also found in this area in front of the bathrooms.

Blue Point Beach

This was the only area within FIIS that did not appear to contain any invasive exotics (Figure 9). There is very little human traffic through this area as most people drive on the beach, thereby avoiding the interior.

Wilderness Area to Watch Hill

The Wilderness Area had few weed species present (Figure 12). Autumn olive was again found, but at present seems restricted to 3 areas: the boundary between FIIS and Smith Point County Park, on either side of the boardwalk at Bellport Beach, and on the western edge of Watch Hill where Davis Park residents have planted it (Figures 10, 11).

Spotted knapweed was found on the border of Smith Point County Park and it was growing in front of houses 1 through 5 at Watch Hill. Like all other areas where it was detected on the island, it appears to occur predominantly in disturbed habitat and is not found where native vegetation predominates.

Nodding thistle seems to be a growing problem all along the island. It appears to have originated at Watch Hill and come from the horse feed. It grows most vigorously where the manure is dumped. Each plant can produce over 10,000 seeds in a season and they are generally wind dispersed and are therefore extremely small. It could be easily transported down the island not only from the horses themselves, but also via vehicles that traverse the park from one end to the other.

Some other exotics that were detected were jimson weed (*Datura stramonium*) at Watch Hill and Oriental bittersweet and multiflora rose that were found growing along the boardwalk at the eastern end of the wilderness area. None of these species were classified as covering more than 25% of the area.

William Floyd Estate

The William Floyd Estate was among the most infested sites surveyed, with 7 weed species present (Figure 13). Autumn olive was the most prevalent exotic species at the estate. It was found in 4 fields on the estate and along the roads near the borders of the estate. The cover class for autumn olive in the fields was determined to be either high or moderate. Other invasive exotic species found there were tree-of-heaven, nodding thistle, multiflora rose, pampas grass spp. (*Cortaderia* spp.), Oriental bittersweet, and Chinese/Japanese wisteria (*Wisteria* spp.). The wisteria spp. appears to be encroaching from residential properties bordering the estate and exists in moderately dense patches in these areas.

CONCLUSIONS

All in all, few exotic species were found on NPS-owned lands. A total of 15 species were found on Fire Island. The most abundant of these were autumn olive, nodding thistle, and spotted knapweed (Table 1). Species such as Japanese barberry (*Berberis thunbergii*), purple loosestrife (*Lythrum salicaria*), and mile-a-minute vine (*Polygonum perfoliatum*) which are growing problems on Long Island do not appear to have escaped cultivation on Fire Island. Even within the communities, these species do not seem to spread.

Fire Island is characterized by poor soils and almost constant salt spray on the ocean side that may be a factor in limiting the number of exotic species that are able to establish here. This, of course, is very fortunate, but as the number of visitors and residents increases each year, there is an increase in the pedestrian, bicycle, and vehicular traffic along the island. This can provide an avenue for exotic plant species to enter the island and the disturbance caused

by this traffic provides the necessary openings in the native vegetation for exotics to become established.

Autumn olive and nodding thistle are prime examples of exotics that spread in this way. Given their current abundance, management measures need to be taken promptly if their spread is to be curtailed. This is also the case with species like Oriental bittersweet and Japanese honeysuckle. Although they are presently not as abundant, their ability to spread rapidly and choke existing native vegetation warrants concern, especially in areas such as the Sunken Forest and the Wilderness Area.

It bears emphasis that it is much easier to treat infestations like this in the early stages, therefore, continuous monitoring of invasive exotics on Fire Island is crucial. Data collected from monitoring efforts will allow management decisions to be made as new infestations are discovered and the spread of existing ones is tracked. Through monitoring and management, perhaps this problem can be kept under control and the biological integrity of the park protected from further compromise.

LITERATURE CITED

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Table 1. Species List and NPS codes.		
Species	Scientific Name	NPS Code
Autumn Olive	<i>Eleagnus umbellata</i>	ELAUMB
Bamboo spp.	<i>Phyllostachys spp.</i>	PHYsp.
Chinese/Japanese Wisteria	<i>Wisteria spp.</i>	other
Common Mullein	<i>Verbascum thapsus</i>	other
Honeysuckle spp.	<i>Lonicera spp.</i>	other
Japanese Honeysuckle	<i>Lonicera japonicus</i>	LONJAP
Japanese Knotweed	<i>Polygonum cuspidatum</i>	POLCUS
Jimson Weed	<i>Datura stramonium</i>	other
Multiflora Rose	<i>Rosa multiflora</i>	ROSMUL
Nodding Thistle	<i>Carduus nutans</i>	other
Oriental Bittersweet	<i>Celastrus orbiculatus</i>	CELORB
Pampas Grass	<i>Cortaderia spp.</i>	other
Spotted Knapweed	<i>Centaurea maculosa</i>	CENMAC
Tree of Heaven	<i>Ailanthus altissima</i>	AILALT
White Poplar	<i>Populus alba</i>	POPALB

Table 2. Survey and attribute data.				
SURVEY DATE	SPECIES	SURVEY AREA	SIZE OF INFESTATION	COVER CLASS
8/9/2002	Nodding Thistle	Atlantique	< .1 acre	Low/occasional plts.
8/9/2002	Nodding Thistle	Atlantique	< .1 acre	Trace/rare
7/17/2002	Autumn Olive	Bellport Beach		Low/occasional plts.
8/7/2002	Spotted Knapweed	Carrington Estate	.1 to 1 acre	Low/occasional plts.
8/9/2002	Japanese Honeysuckle	Kismet		Low/occasional plts.
8/9/2002	Oriental Bittersweet	Kismet		Trace/rare
8/9/2002	Nodding Thistle	Kismet	.1 to 1 acre	Low/occasional plts.
8/9/2002	Bamboo spp.	Kismet	.1 to 1 acre	High/fairly dense
7/23/2002	Autumn Olive	Lighthouse Tract	.1 to 1 acre	Low/occasional plts.
7/23/2002	Autumn Olive	Lighthouse Tract	< .1 acre	Trace/rare
7/24/2002	Spotted Knapweed	Lighthouse Tract		Moderate/scatt.plts.
7/24/2002	Nodding Thistle	Lighthouse Tract	.1 to 1 acre	Moderate/scatt.plts.
7/24/2002	Autumn Olive	Lighthouse Tract	< .1 acre	High/fairly dense
7/24/2002	Autumn Olive	Lighthouse Tract	.1 to 1 acre	Moderate/scatt.plts.
7/24/2002	Autumn Olive	Lighthouse Tract	< .1 acre	Trace/rare
7/24/2002	Multiflora Rose	Lighthouse Tract	< .1 acre	Low/occasional plts.
7/24/2002	Autumn Olive	Lighthouse Tract	< .1 acre	Trace/rare
7/24/2002	Autumn Olive	Lighthouse Tract	.1 to 1 acre	Low/occasional plts.
7/24/2002	Japanese Honeysuckle	Lighthouse Tract	< .1 acre	Low/occasional plts.
8/7/2002	Autumn Olive	Lighthouse Tract		Low/occasional plts.
8/7/2002	Autumn Olive	Lighthouse Tract	.1 to 1 acre	Low/occasional plts.
8/7/2002	Common Mullein	Lighthouse Tract	.1 to 1 acre	Low/occasional plts.
8/15/2002	Oriental Bittersweet	Lighthouse Tract	< .1 acre	Low/occasional plts.
8/15/2002	Oriental Bittersweet	Lighthouse Tract	< .1 acre	Low/occasional plts.
8/15/2002	Oriental Bittersweet	Lighthouse Tract	< .1 acre	Moderate/scatt.plts
8/9/2002	Autumn Olive	Robbins Rest		Moderate/scatt.plts
8/9/2002	Autumn Olive	Robbins Rest	< .1 acre	Trace/rare
8/9/2002	Autumn Olive	Robbins Rest	< .1 acre	Trace/rare
8/9/2002	Honeysuckle spp.	Robbins Rest	.1 to 1 acre	Low/occasional

				plts.
8/9/2002	Autumn Olive	Saltaire Area		Moderate/scatt.plts.
8/9/2002	Japanese Honeysuckle	Saltaire Area		Low/occasional plts.
8/9/2002	Nodding Thistle	Saltaire Area	1 to 5 acres	Low/occasional plts.
8/9/2002	White Poplar	Saltaire Area	< .1 acre	Trace/rare
7/26/2002	Spotted Knapweed	Sunken Forest		Low/occasional plts.
7/26/2002	Spotted Knapweed	Sunken Forest		Low/occasional plts.
7/26/2002	Japanese Honeysuckle	Sunken Forest	< .1 acre	Low/occasional plts.
7/26/2002	Multiflora Rose	Sunken Forest	< .1 acre	Trace/rare
7/26/2002	Japanese Honeysuckle	Sunken Forest	< .1 acre	Trace/rare
7/26/2002	Autumn Olive	Sunken Forest	< .1 acre	Trace/rare
7/26/2002	Nodding Thistle	Sunken Forest	< .1 acre	Trace/rare
7/26/2002	Nodding Thistle	Sunken Forest	.1 to 1 acre	Low/occasional plts.
7/26/2002	Spotted Knapweed	Sunken Forest	.1 to 1 acre	Low/occasional plts.
7/31/2002	Spotted Knapweed	Sunken Forest		Low/occasional plts.
7/31/2002	Japanese Knotweed	Sunken Forest	< .1 acre	Trace/rare
8/1/2002	Spotted Knapweed	Talisman		Low/occasional plts.
8/1/2002	Spotted Knapweed	Talisman		Low/occasional plts.
8/1/2002	Spotted Knapweed	Talisman	.1 to 1 acre	Low/occasional plts.
8/1/2002	Nodding Thistle	Talisman	< .1 acre	Trace/rare
7/22/2002	Spotted Knapweed	Watch Hill		Trace/rare
7/22/2002	Jimson Weed	Watch Hill	.1 to 1 acre	Low/occasional plts.
7/22/2002	Autumn Olive	Watch Hill	< .1 acre	Low/occasional plts.
7/22/2002	Spotted Knapweed	Watch Hill	.1 to 1 acre	Trace/rare
7/22/2002	Nodding Thistle	Watch Hill	.1 to 1 acre	Trace/rare
8/15/2002	Nodding Thistle	Watch Hill	< .1 acre	Moderate/scatt.plts.
7/9/2002	Autumn Olive	Wilderness Area		Low/occasional plts.
7/16/2002	Spotted Knapweed	Wilderness Area		Low/occasional plts.
9/25/2002	Oriental Bittersweet	Wilderness Area		Low/occasional plts.
9/25/2002	Multiflora Rose	Wilderness Area	< .1 acre	Low/occasional plts.

8/27/2002	Multiflora Rose	William Floyd Estate	< .1 acre	Low/occasional plts.
8/27/2002	Autumn Olive	William Floyd Estate	.1 to 1 acre	Low/occasional plts.
8/27/2002	Multiflora Rose	William Floyd Estate	< .1 acre	Trace/rare
8/27/2002	Multiflora Rose	William Floyd Estate	< .1 acre	Low/occasional plts.
8/27/2002	Oriental Bittersweet	William Floyd Estate	< .1 acre	Low/occasional plts.
9/6/2002	Other	William Floyd Estate	.1 to 1 acre	Moderate/scatt.plts.
9/6/2002	Tree of Heaven	William Floyd Estate	.1 to 1 acre	Moderate/scatt.plts.
9/6/2002	Other	William Floyd Estate	< .1 acre	Low/occasional plts.
9/6/2002	Autumn Olive	William Floyd Estate	1 to 5 acres	Moderate/scatt.plts.
9/6/2002	Autumn Olive	William Floyd Estate	1 to 5 acres	High/fairly dense
9/6/2002	Autumn Olive	William Floyd Estate	1 to 5 acres	Moderate/scatt.plts.
9/6/2002	Autumn Olive	William Floyd Estate	1 to 5 acres	High/fairly dense
9/9/2002	Other	William Floyd Estate	.1 to 1 acre	Low/occasional plts.